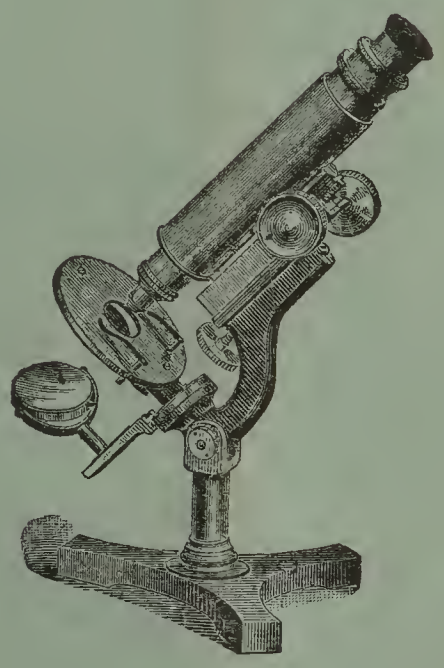
THE

MICROSCOPICAL BULLETIN

AND

SCIENCE NEWS.



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American Society of Microscopists

1887 MEETING.

We wish to call attention to the fact that the 1887 meeting of the national society is close at hand. The Iron City Microscopical Society requests us to make the announcement which follows; their energy and courtesy shown in connection with the coming meeting are, we think, worthy of warm recognition. To judge from what has come to our knowledge they are doing everything that can be done to make the meeting a grand success.

NOTICE.

The Iron City Microscopical Society, desiring that as many as possible may enjoy the pleasure and profit to be derived from the meeting of the American Society of Microscopists, to be held at Pittsburgh August 30th to September 2d, cordially invites all interested in the study of microscopy to attend.

Circulars and programmes will be mailed to all wishing to attend upon application to James H. Logan, corresponding secretary, room 804, Penn Building, Pittsburgh, Pa.

JUST as we go to press, the death is announced of Spencer F. Baird, who has been for many years at the head of the Smithsonian Institution and U. S. Fish Commission; also, of Alvan Clark, Sr., of the famous firm of telescope makers, A. Clark & Sons. Both died on the 19th inst.

Tests for Definition, Penetration, etc.

E. M. NELSON.

This is an important subject, about which a great amount of misconception exists. Let us first get at the meaning of the words. According to Goring, Pritchard, and Brewster in 1837, "Quekett," second edition, 1852, "Jabez Hogg," second edition, 1855, penetration or "separating power" = resolving power; definition = freedom from spherical and chromatic aberrations. So also *Micrographic Dictionary*, third edition, 1875, with this exception, that according to it, separating power = magnifying power. In "Carpenter," fifth edition, 1875, penetration = focal depth; so also in Beale, fifth edition, 1880. Probably the term "penetration" came to mean resolution from the phraseology used in connection with Herschel's monster telescope "penetrating" into space and resolving very minute stars which were thought to be immensely farther off than the more conspicuous ones.

The word "penetration" is now used solely with reference to depth of focus.

The qualities of an object-glass are six in number:

1. Magnifying power.
2. Resolving power.
3. Penetrating power.
4. Illuminating power.
5. Flatness of field.
6. Defining power.

1. No test is required for this, as it can be directly measured. Imagine any one saying that a scale of Morpho Menelaus was a good test of magnifying power!

2. Resolving power is simply numerical aperture, or N.A. This can also be directly measured, therefore no test is necessary.

3. Penetrating power is the reciprocal of resolving power, or $\frac{1}{\text{N.A.}}$ No test is necessary.

4. Illuminating power is $(\text{N.A.})^2$, or N.A. multiplied by itself; no test is necessary.

5. Flatness of field. Tests for low powers, a micro-photograph; for medium powers, a stage micrometer; for high powers, a slide of minute bacteria or micrococci, dried on cover

and stained. This is not so important as usually supposed, especially in high powers.

6. Defining power depends, as we have seen, on the freedom of the lens from spherical and chromatic aberrations. Of these two, the spherical is the all-important one.

Of the method of testing lenses for this point, I have treated already at length in these columns, therefore will merely say that it is performed by viewing a suitable object illuminated by solid right cones of light, the object being placed in the apex of the cone. Cones of small angles should first be used, and then enlarged until the object begins to get pale, milky, or foggy. On removing the eye-piece and looking down the tube at the back lens of the objective, it will be seen what portion of the lens is filled with light, thereby determining at what point in the aperture of the objective the spherical aberration begins to operate, the best lens being that which will stand the most light. Flooding an object with too much light is only another name for spherical aberration in the object-glass. A good objective is one which cannot be flooded. Suitable tests for spherical aberration:

Very low powers, 3, 2, 1½-in., wing of Agrion pulchellum ♂ (dragon fly).

Low powers, 1, ⅔-in., proboscis of blow-fly squeezed flat.

Medium powers, ½, $\frac{4}{10}$, low-angled ¼-in., minute hairs on proboscis of blow-fly; hair of pencil tail (Polyxenus lagaries); diatoms on a dark ground.

Medium powers, wide angled, ¼, ⅕, ⅙-in., P. formosum and N. lyra in balsam or styrax; bacteria and micrococci stained.

High powers, wide angled immersions, the secondary structure of diatoms, especially the fracture through them. Navicula rhomboides in balsam or styrax, bacteria and micrococci stained.

Chromatic aberration is not so important as the spherical, because some very fine object-glasses have a good deal of outstanding color.

Tests for low powers: thin section of deal, the coarse structure. Medium powers: the discs in ditto. High powers: Podura scale and P. formosum. So it will be seen that there is only one point of paramount importance in an objective to be tested, and that is its spherical aberration. The other qualities can be measured.—*Eng. Mech.*

(*Extracts.*)

Notes on Microscopical Methods.

By Simon H. Gage.

Air bubbles.—Prepare these by placing a drop of mucilage on the centre of a slide and beating it with a scalpel blade until the mucilage looks milky from the inclusion of air bubbles. Put on a cover-glass (Hist. Notes, § 3, 6), but do not press it down.

Air bubbles with central illumination.—Shade the object; and with the plane mirror, light the field with central light.

Search the preparation until an air bubble is found appearing about 1 mm. in diameter. If the light is central the air bubble will appear with a wide dark circular margin and a small bright centre. If the bright spot is not in the centre, adjust the mirror until it is.*

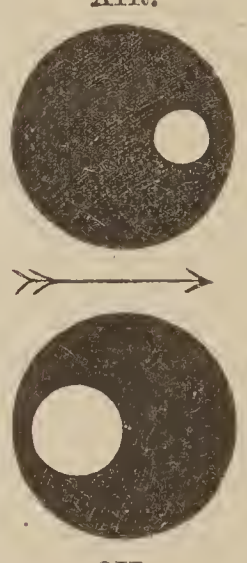
Focus both up and down, noting that in focusing up the central spot becomes very clear and the black ring very sharp. On elevating the body still more the centre becomes dim, and the whole bubble loses its sharpness of outline.

Air bubbles with oblique illumination.—Remove the substage of the microscope and all the diaphragms. Swing the mirror so that the rays may be sent very obliquely upon the object. The bright spot will appear no longer in the centre but on the side *away from* the mirror.

Oil globules.—Prepare these by beating a small drop of clove oil with mucilage on a slide and covering as directed for air bubbles.

Oil globules with central illumination.—Use the same diaphragm and light as above. Find an oil globule appearing about 1 mm. in diameter. If the light is central the bright spot will appear in the centre as with air. Focus up and down as with air; and note that the bright centre of the oil globule is clearest *last* in focusing up.

Oil globules with oblique illumination.—Remove the substage, etc., as above, and swing the mirror to one side and light with oblique light. The bright spot will be eccentric, and will appear to be on the *same* side as the mirror.



Oil and air together.—Make a preparation exactly as described for air bubbles, and add at one edge a little of the mixture of oil and mucilage; cover and examine.

The substage need not be used in this experiment. Search the preparation until an air bubble and an oil globule, each about 1 mm. in diameter, are found in the same field of view. Light first with central light, and note that in focusing up the air bubble comes into focus first and that the central spot is smaller than that of the oil globule. Then, of course, the black ring will be wider in the air bubble than in the oil globule. Make the light oblique. The bright spot in the air bubble will move *away from* the mirror while that in the oil globule will move *toward* it.† (See figure.)

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* This is one of the simplest and surest methods of telling when the light is central or axial.

† It should be remembered that the image in the compound microscope is inverted (see figure), hence the bright spot really moves toward the mirror for air, and away from it for oil.

Air and oil by reflected light.—Cover the diaphragm or mirror so that no transmitted light can reach the preparation, using the same preparation as in § 38 (*oil and air together*). The oil and air will appear like globes of silver on a dark ground. The part that was darkest in each will be lightest, and the bright central spot will be somewhat dark.*

Distinctness of outline.—This depends on the difference between the refractive power of a body and that of the medium which surrounds it. The oil and air were very distinct in outline as each differed greatly in refractive power from the medium which surrounded them, the oil being more refractive than the mucilage, and the air less.

Place a fragment of a cover-glass on a clean slide, and cover it (Hist. Notes, § 6). The outline will be very distinct with the unaided eye. Use it as object and employ $\frac{3}{4}$ objective and C ocular. Light with central light. The fragment will be outlined by a dark band. Put a drop of water at the edge of the cover-glass. It will run in and immerse the fragment. The outline will still be distinct, but the dark band will be somewhat narrower. Remove the cover-glass, wipe it dry, and wipe the fragment and slide dry also. Put a drop of glycerin on the middle of the slide and mount the fragment of cover-glass in that. The dark contour will be much narrower than before.

Draw a solid glass rod out to a fine thread. Mount one piece in air and the other in glycerin. Put a cover-glass on each. Employ the same optical arrangement as before. Examine the one in air first. There will be seen a narrow, bright band, with a wide dark band on each side.

The one in glycerin will show a much wider bright central band, with the dark borders correspondingly narrow.

If the glass rod or any other object were mounted in a medium of the same color and refractive power, it could not be distinguished from the medium.

Doubly contoured.—This means that the object is bounded by two, usually parallel, dark lines with a lighter band between them. In other words, the object is bordered by (1) a dark line, (2) a light band, and (3) a second dark line.

This may be demonstrated by coating a fine glass rod with one or more coats of collodion or celloidin and allowing it to dry and then mounting in glycerin as above. Employ a $\frac{1}{5}$ or higher objective, light with transmitted light, and it will be seen that where the glycerin touches the collodion coating there is a dark line—next this is a light band, and finally there is a second dark line where the collodion is in contact with the glass rod.

Optical section.—The appearance obtained in examining transparent or nearly transparent objects with a microscope when some plane below the upper surface of the object is in focus. The upper part of the object which is out of focus obscures the image but slightly. By changing the position of the objective or object, a different plane will be in focus and a different optical section obtained. The most satisfactory optical sections are obtained with high objectives having wide angles.

Nearly all the transparent objects studied may be viewed in optical section. A striking example will be found in studying mammalian red blood-corpuscles on edge (Hist. Notes, § 13, 14).

Magnification and Ocular Micrometer Ratio.—The magnification, amplification, or magnifying power of a microscope or any of its parts is the number obtained by dividing any linear dimension of the image by the corresponding linear dimension of the object magnified. For example, if the image of some object is 40 mm. long, and the actual length of the object magnified is 2 mm. the magnification is 40÷2=20.

Magnification is expressed in diameters or times linear—that is, but one dimension is considered.

Distance at which the Image is Measured.—While the image may be measured and the magnification determined at various distances, it is evident that the size of the image, and hence the magnification, depends directly upon the distance at which it is measured from the apex of the triangle inclosing it, hence, in order that results may be uniform and comparable, it is necessary to agree upon some arbitrary distance at which the image shall be measured. The distance chosen is 25 cm. (10 inches approximately).

Cover-Glass—Cover-Correction.—General Directions.—(A) The thinner the cover-glass the further must the systems of lenses be separated, *i. e.*, the adjusting collar is turned nearer the zero or the mark "uncovered," and conversely. (B) The thicker the cover-glass, the closer together are the systems brought by turning the adjusting collar *from* the zero mark. This also increases the magnification of the objective.

The following specific directions for making the cover-glass adjustment are given by Mr. Wenham [(C. 166), Q. j. m. s. 1854, p. 137)]: "Select any dark speck or opaque portion of the object, and bring the outline into perfect focus; then lay the finger on the milled-head of the fine motion, and move it briskly backward and forward in both directions from the first position. Observe the expansion of the dark outline of the object, both when within and when without the focus. If the greater expansion, or coma, is when the object is *without* the focus, or farthest from the objective [*i. e.*, in focusing up], the lenses must be placed farther asunder, or toward the mark uncovered [*i. e.*, the adjusting collar is turned toward the zero mark, as the cover-glass is too thin for the present adjustment]. If the greater expansion is when the object is within the focus, or near-

* It is possible to distinguish oil and air optically [in this way.—Ed. M. B.] only when they are in small spherical masses. Oil and fatty substances may be distinguished chemically, no matter what their form, by the use of osmic acid, which blackens them (Hist. Notes, § 77).

est the objective [*i. e.*, in focusing down], the lenses must be brought closer together or toward the mark covered [*i. e.*, the adjusting collar should be turned away from the zero mark, the cover-glass being too thick for the present adjustment]." In most objectives the collar is graduated arbitrarily, the zero (0) mark representing the position for uncovered objects. Other objectives (Zeiss' and Leitz's, also some by Powell & Leland) have the collar graduated to correspond to the various thickness of cover-glasses for which the objective may be adjusted. This seems to be an admirable plan; then if one knows the thickness of the cover-glass on the preparation (Hist. Notes, § 25, note), the adjusting collar may be set at a corresponding mark, and one will feel confident that the adjustment will be approximately correct. It is then only necessary for the observer to make the slight adjustment to compensate for the mounting medium or any variation from the standard length of the body of the microscope. In adjusting for variations of the length of the body from the standard it should be remembered that: (A) If the body of the microscope is longer than the standard for which the objective was corrected, the effect is approximately the same as thickening the cover-glass, and therefore the systems of the objective must be brought closer together, *i. e.*, the adjusting collar must be turned *away from* the zero mark. (B) If the body is shorter than the standard for which the objective is corrected, the effect is approximately the same as diminishing the thickness of the cover-glass, and the systems must therefore be separated, that is, the adjusting collar turned *toward* the zero mark.

Meetings of Societies.

Pioneer Hall was thronged on the evening of the 28th of May, on the occasion of the annual reception tendered by the members of the San Francisco Microscopical Society to their friends. The audience comprised many of the most prominent names in the social, scientific, and educational circles of the city, and the entertainment was evidently thoroughly enjoyed by all present. Never before has such a display of microscopes been seen on the Pacific coast. The list of objects shown was a most attractive one, and, as the best of lenses were used in their display, and careful attention was given to obtaining the best effects of illumination, the results were eminently satisfactory. It may incidentally be remarked as a fact most gratifying to all interested in the progress of microscopical investigation on the Pacific coast, that, although the local microscopical society is one of the oldest in the country—being now in its fifteenth year—it has lost none of its vitality, but has, on the contrary, at present a larger membership, a larger and finer library and cabinet, a larger average attendance at meetings, and in every way better prospects for useful work in the future, than at any previous time in its history.

Atoms and Items.

At the June meeting of the Trenton Natural History Society, Dr. T. S. Stevens said that he had recently found a colony of the beautiful Polyzoa, *Cristatella*, this being the first instance of its capture in this locality. For several years another member has been carefully searching the ponds for these splendid animals, but has never found them. Recently, in the pond at Morrisville, the statoblasts, or winter eggs, were observed, and in an unguarded moment this fact was told to Dr. Stevens, who then, with very great self-possession, went across the river and made himself obnoxious by finding the living animals. It is such occurrences that destroy the disposition and upset the equilibrium of the working naturalist. The consolation in this case is, that Dr. Stevens has never seen the statoblasts, and his colony was a very young one, and it was only about one-sixth the mature size, and it lived only a short time, and it wasn't much of a find anyway!—*Local paper.*

Specimens of the interesting little alga *Chlamydococcus pluvialis* were sent in by Dr. H. W. Harkness at a recent meeting of the San Francisco Microscopical Society. The bright-red globose cells bear a strong resemblance to those of *C. nivalis*—the microscopic plant producing the phenomenon known as "red snow." A slide of the latter gathered in the Sierra Nevada Mountains, near Donner Lake, was also exhibited to show the close similarity between the two plants. In fact, the later authorities are inclined to regard them as not specifically distinct, but differing only in habitat, *C. pluvialis* being the plant as found in rain water, and *C. nivalis* as found in snow. The cells possess the remarkable property of retaining vitality after being kept dry for years, for as soon as moisture is supplied vegetation again commences.

Paper for Cleaning the Lenses of Objectives and Oculars.—For the last two years the so-called Japanese filter paper (the bibulous paper often used by dentists when filling teeth) has been used in the laboratory for cleaning the lenses of oculars and objectives, and especially for removing the fluid used with immersion objectives. Whenever a piece is used once it is thrown away. It has proved more satisfactory than cloth or chamois, because dust and sand are not present; and from its bibulous character it is very efficient in removing liquid or semi-liquid substances. At the writer's suggestion it was tried in the Bureau of Animal Industry at Washington, and is now used there almost exclusively for the purpose named above.—*S. H. Gage.*

There is altogether too much selfishness in this world, and many a man lives and dies with his knowledge hidden in his own brain, of use to himself perhaps, for a time, but of no benefit to the world. Let this be said of no microscopist. Certainly the wonderful instrument by whose power the hidden things of nature are

revealed should give to us a broadness of mind and character, and a charity toward all men, so that when our little light has flickered out it may be said of us that we lived not in vain, and, that noblest monument of all, our works do follow us. Lend a hand.—*The Microscope.*

Transference of Sections.

By Arthur C. Cole.

Thick sections, such as are used for opaque objects, can be handled anyhow, but sections only 1-600 of an inch thick, and still thinner, have to be transferred from one place to another with great tact and care, or they are torn and disfigured. Sections are transferred by floating, by camel-hair brushes, by lifters, etc. Many histologists recommend the first as the only method of dealing with the more delicate sections. By practice, however, the two latter methods may be safely used. Section lifters should be kept of two sizes for large and small sections. Further, one of each size should have holes drilled through it to freely allow fluid to pass through. This is advantageous, as it allows the lifter to retain the section with certainty, while a section in water or spirit will float away from a lifter not so perforated, in consequence of the thin layer of water which remains between the surface of the lifter and the section, carrying the section away. The lifters not perforated are used to carry the section from the clearing-oil to the slide. In this case a thin layer of oil must remain between lifter and section, or the latter will *not* float off, but will have to be dragged off and will be very likely torn. We advise amateurs to remove sections by means of lifters and brushes, but until they have acquired the art of doing so without injuring the sections, they will do well to avail themselves of the floating method in the case of their delicate and valuable sections.

1st. *The floating method.*—When sections are transferred *en masse* from one vessel to another, they may be boldly poured in like water alone, using a wide funnel, and ignoring the presence of the sections—from a saucer into a wide-mouthed bottle, for instance. When a section is to be landed upon the exact centre of a slide, when it is a very thin, tender section, and when it requires skill to prevent creases, we effect this by holding our slide in our left hand and a camel-hair brush in the other. We then dip the slide into the fluid in which the section is floating, and gently bring its exact centre under the section, and place the brush upon the edge of the section nearest to our left hand; we now withdraw the whole. If we find the section in creases, and not lying flat on the slide, it is easy while we hold it with the brush on its left border, to float it out and spread it out evenly before altogether withdrawing it.

2d. *Transferring with brushes.*—Small camel-hair brushes with few but long hairs are used. The brush is merely dipped under the section and raised. The section then sits like a saddle upon the brush and can be transferred to another fluid by the most unpracticed without injury. If, however, the section is to be spread out on a dry slide, the matter is more difficult. In such a case we allow the most dependent part of the section to come down on the slide first and the slight drag of this part on the slide enables us to get the brush from under the section by revolving the brush on its long axis—*i. e.*, *away* from that portion of the section which is touching the slide. This manœuvre is a little difficult, but is a most useful method of transferring a section to a slide and at the same time spreading it out flat.

3d. *By section lifters.*—We insert the lifter beneath the section with our left hand, while with the mounted needle or a brush, to fix the edges of the section nearest to our left upon the slide and withdraw the whole. If the section be lifted from the clearing-oil to the slide, the superfluous oil is got rid of by touching a dry, clean slide once or twice with the edge of the lifter. If, however, we drain away all of the oil, and the section is delicate, or large and delicate, it will adhere to the lifter and be torn in attempting to draw it upon the slide from the lifter, which we do by our needle or brush. It requires, therefore, some experience to stop short of withdrawing too much oil from the lifter and section. It is a fault in the right direction to float any amount of oil upon the slide from the lifter, rather than to drag and tear the section, after withdrawing too much oil. To get rid of the oil on the section as it lies on the slide is quite easy. We incline the slide on its end by rearing it against any perpendicular body and the oil drains away down the slide, whose lowest end should rest on blotting-paper. After a little while we bring a piece of blotting-paper upon the section, whilst the slide is lying section upward, and stroke our right hand *firmly* over it, exactly as we should do were it wet ink on a sheet of note-paper. The section, however delicate, is safely and thoroughly deprived of its oil by this means and not injured in the least. The blotting-paper may have to be brought down on the section in two fresh places rapidly, one after the other. This leaves the section ready for our benzole balsam.—*Methods of Mic. Research.*

Photomicrograph versus Microphotograph.

A. Clifford Mercer, M. D., Syracuse, N. Y.

The confusion of the terms "photomicrograph" and "microphotograph" has led the writer to try to discover the paternity and original meaning of the more important word, photomicrograph.

During the past eighteen months, through the kind interest of Dr. R. L. Maddox himself, and through him of the editors of the *British Journal of Photography*, the looked-for paternity has been discovered. Traced to Mr.

George Shadbolt, he has acknowledged the child, writing: "I believe I am responsible for drawing attention to the necessity of a distinction between a photographic picture of an enlarged object and the minute photographic picture of a large object, the former being correctly described as a 'photomicrograph' and the latter as a 'microphotograph,' in accordance with the meaning of the original Greek derivatives. This will have been in an early number of the *British Journal of Photography*, probably while it was still called '*The Liverpool Journal of Photography*.'"

The exact date of the birth of the word is still somewhat doubtful, but Dr. Maddox writes: "I think we may safely put it at '59 or '60, although we cannot put our finger on the page, even after much research."

The two acknowledged leaders in photomicrographic literature in the two great English-speaking countries, Drs. Maddox and Woodward, throughout their writings have used the words in question with the clearly defined Shadbolt distinction; and the writer trusts, with this historical note recorded in our Proceedings, the American Society of Microscopists, as a body and as individuals, will insist upon the correct usage of these terms.

A photomicrograph is a macroscopic photograph of a microscopic object; a microphotograph is a microscopic photograph of a macroscopic object.

Discussion.—In discussing this paper, Professor W. A. Rogers took occasion to recommend the use of the term *mikron* instead of micromillimeter, in which Professor W. H. Seaman concurred.—*Proc. Am. Soc. Microscopists.*

The New Objectives and Oculars.

(Extracts from a paper by Prof. E. Abbe.)

Whatever may prove to be the final result, the principle of construction of objectives as here developed must in any case lay claim to a certain interest from the purely optical point of view, as regards the essentially higher *order* of collection of rays which is realized by it.

In the language of dioptrics this order is determined by the number of rays *different* in direction of incidence or in refrangibility, which, in virtue of the conditions fulfilled by the optical system, are *completely* united in a single point in the axis.

Upon the number of these rays depend the greater or less limits within which the other rays may vary which are not completely, but only approximately united; and these limits are a natural measure of the more or less complete concentration of the rays altogether.

In this sense an ordinary simple glass lens represents a collection of the rays in its axis of the first order. The objectives of the large telescopes which are made now, exhibit for the most part a concentration of the third order, and it is only these telescopes which are made strictly after the Fraunhofer or the Gauss type of construction which attain the fourth order.

Now of the microscope objectives which are here considered, those with the greatest aperture in the different classes have a concentration of rays of not less than the eleventh order; *three* different kinds of rays are brought under strict conditions by the removal of color-deviation, including secondary dispersion; *six* by the elimination of spherical aberration and its chromatic difference with such large aperture; and, finally, *two* more by the production of equal magnifying power for the different zones of the free opening. To this corresponds the enormous size of the free opening which is employed with microscope objectives as compared with telescope objectives; whereas in the latter an opening which is only the tenth *part* of the focal length is quite exceptional, at least in the larger instruments, the microscope objective of the present time requires openings the diameter of which are 2·8 *times* the focal length.

Eye-Pieces.

* * * * The demand, that with the new objectives a high magnifying power in the eye-piece should be provided for systematic work, requires a considerable alteration in the construction of the stronger eye-pieces so as to free them from the disadvantages by which they are at present beset. The types of eye-piece which have been hitherto used, both the ordinary Huyghenian and the different achromatic eye-pieces, if their focal length falls much below 25 mm., require eye-lenses of very small diameter, and moreover, with them the eye-point lies very close to the lens. On this account the observer must bring his eye inconveniently near, and in particular the use of the camera lucida is prevented. By a type of construction which is essentially different from the forms in use, the compensation eye-pieces may be rendered quite as convenient for the higher powers as is the case with the weak and medium eye-pieces now employed. The diameter of the eye-lens is considerable, and the eye-point is so far from the lens *that the camera lucida may be used without any difficulty.—Jour. R. M. S.*

Interesting Results of Recent Investigations.

(from the journal of the royal microscopical society.)

Polypes Turned Outside In.—Herr M. Nussbaum gives an account of experiments on *Hydra*, in which he tested the often-repeated assertion, based on the authority of Trembley, that in a *Hydra* turned outside in, ectoderm became endoderm, and endoderm ectoderm, and all was again in *statu quo*. This is not the case. After a time, according to Nussbaum, an outer ectoderm is, indeed, recognizable, but this originates, not by the modification of the everted

ectoderm, but as a growth from the tentacles and basal pore.

His further experiments led him to these three conclusions:—(1) That the nature of tissues is constant, ectoderm is always ectoderm, and cannot become endoderm; (2) that for reconstruction of the whole from a part, that part must contain representative portions of all three layers; (3) that the artificial division of Protozoa and Polypes lends support to the theory of heredity suggested by Jäger, clearly enunciated by Nussbaum, and recently developed by Weismann—the theory of the continuity of the germinal protoplasm.

Contractile Vacuoles of Infusoria.—Herr S. Fischer has investigated the contractile vacuoles of *Aspidisca lynceus* and *Paramœcium aurelia*. The former infusorian had three pulsating vacuoles; the largest to the right of the mouth with regular pulsations; the second of smaller size and posterior position, with pulsations alternating with those of the former; while the third and smallest exhibited irregular and less frequent pulsations. At the maximum diastole of the largest a thin drop appears close beside it, which increases gradually during the systole, and becomes the new vacuole. In *Paramœcium* the vacuole at its maximum extension is surrounded by a system of delicate canals, slightly swollen at a certain distance from the vacuole. During the systole the swollen extremities gradually come into contact to form a new vacuole. There is thus no definite membrane round the vacuoles. The contents were seen in *Aspidisca* to be expelled to the exterior. The pulsations are accelerated in deficient aeration of the water.

Rhizopod-like Digestive Organs in Carnivorous Plants.—Herren A. Kerner v. Marilaun and R. Wettstein v. Westersheim describe the contrivances for the capture and digestion of insects in *Lathræa squamaria* and *Bartsia alpina*. On the back of the underground non-chlorophyllaceous leaves of *Lathræa* are cavities, the inner walls of which are clothed with glandular organs of two kinds, stalked capitate hairs and sessile 2–4-celled sterile elliptical organs, the latter in connection with the vascular-bundle system of the leaf. The other membrane of both organs is provided with extremely regular perforations, from which, under certain circumstances, extremely fine protoplasmic threads project outward. These threads come into contact with the products of decomposition of the animals (infusoria, mites, etc.) which perish in the cavities. No excretion of any special fluid could be detected. At the commencement of the period of vegetation, the absorption of nutriment in *Lathræa* takes place chiefly through the haustoria, and the quantity of the remains of animals found in the cavities is extremely small. Toward autumn the haustoria partially disappear, and the number of insects captured increases.

In *Bartsia alpina* similar organs are found in peculiar hollows formed by the leaves, the margins of which are recurved in vernation. The leaf-buds are underground, and the structure of the cavities is similar to that in *Lathræa*.

Structure of Diatoms.—Mr. H. Morland supports the view that in *Navicula Durrandii* the dots are nothing but minute perforations; but he cannot regard the median line or raphe as merely a thickening for strengthening the valve generally; he considers it, on the contrary, to be simply a cleft with thickened borders. In this species he has sometimes noticed, when examining the raphe, that it has two borders, in consequence of the cleft being slightly oblique, one of which, under a high power, will be seen to be on the "upper" surface, while the other is on the "inner" surface; but if the ends of these borders be examined, it will be found that they join each other. The same is the case in *Pleurosigma balticum*.

By the examination of carefully prepared sections of Jutland "cementstein," Mr. Morland confirms Prinz and Van Ermengem's statements with regard to the structure of the diatoms contained in it.

Lactic Fermentation.—Herr G. Marpmann remarks on the very contradictory views still prevailing as to the nature of lactic fermentation. During the past summer he has investigated the micro-organisms of cows' milk in the neighborhood of Göttingen, and has detected five seemingly new and different species, which more or less strongly induce lactic fermentation in cane sugar as well as in milk.

"Foul brood" of Bees.—Dr. Ciesielski describes the mode in which this disease is caused by the newly discovered *Bacillus Preussii*. It develops in the intestinal canal of the larva, destroying the entire body by its rapid increase. In each bacillus are formed four spores toward the end of its development, which germinate only within the bee, and develop again into the bacillus.

Chemical Composition of Bacillus anthracis.—Dr. M. Nencki states that analysis of pure spore-material of *B. anthracis* gives only traces of mycopotein, the principal ingredient being a proteinaceous substance nearly allied to mucine, soluble only in alkalies, which he calls mycomucine. The pathogenic properties of the bacillus are not due to the presence of a poisonous alkaloid, but to its direct action in destroying the living protoplasm of the cell.

Observation of Opaque or Quasi-opaque Objects in the Microscope.

By Dr. John Anthony.

Given a microscope, an objective, and a good "bull's-eye" side-light, the examination of opaque or quasi-opaque objects would seem to be a very simple affair, but experience teaches that much management is required to bring out all the points of structure in an object, or in

making such object show at its best in any subsequent examination.

A very large class of objects examined by aid of the microscope are either opaque or semi-opaque. No one can doubt that if we are able to make out the structure of an object by merely looking *upon* its surface, the result is far more satisfactory than can be got by any process of seeing *through* it. But some objects which are semi-opaque, though the amount of transparency be but small, lend themselves to a combination of both methods, and the effect of this double lighting properly balanced is charming and instructive beyond expression. This may be instanced in the examination of the beautiful whole-insect preparations of Mr. Enock. * * * The effect, when properly got, is little less than magical, so much so, that even the advanced microscopist would not find his time wasted by practising this double illumination on some rather intractable object.

In this double-lighting sometimes a better effect can be got by using the spot-lens instead of the achromatic condenser, in aid of the bull's-eye or silver side-reflector. * * *

Where there is a want of transparency in the object, then the use of the lieberkuhn comes in with advantage. This lieberkuhn was much in vogue in the early days of the microscope, and its use is not to be despised for certain objects; it fell into disfavor from a tendency to illuminate an object equally all round, and to afford no contrast of light and shadow, no "boldness of image;" but this quasi defect is very readily obviated by blacking about one-third of the silver reflecting surface with Indian ink, which does no sort of damage, and so a preponderance of light on one side can be got *of a very pure quality*, and with the advantage—a very great one—that with the finger and thumb grasping the tube of the lieberkuhn, the illumination can be made to revolve in azimuth and so bring out salient points under every condition of light and shadow—a mode of verification which no searcher for truth would be disposed to neglect. * * *

When an object is absolutely opaque the following method would seem to fulfill all the conditions for its examination. Half a dozen pill-boxes are selected of a size to drop like caps on to the achromatic condenser, which is assumed to be always in position for use. On the outside flat part of these pasteboard caps are gummed rounds cut from various colored French unglazed papers; these colors preferably shades of green, from emerald to olive, inasmuch as the chitin, which is so preponderant in all insect preparations, is a shade of red, and the "complementary color" of red is, of course, green. This law of "complementaries," or contrasts will be found to aid most agreeably in the display of an object, and to add much to its distinctness. The primary or secondary colors, or even neutral tints, may be used at will, as a color-battery of this kind would not be costly, and it is evident that little or no trouble would be involved in the substitution of caps, without any disturbance of the side-light; or by racking the condenser armed with this color-cap to form a tinted background of the desired shade or brightness, having the advantage of absolute freedom from glare, and forming a contrast to the local color of the object under examination. * * *—*Jour. R. M. S.*

Publications Received.

ELEMENTARY MICROSCOPICAL TECHNOLOGY: Part I (complete in itself). The Technical History of a Slide, from the crude materials to the finished mount. By Frank L. James, Ph.D., M.D. 107 pp., illustrated. St. Louis, 1887.

This is "a manual of the art of mounting," which appears to be practical and valuable; we think there has been a need for something better or more recent than the other handbooks of mounting that we now call to mind. An index, which appears to be quite full, increases its value. Prices: flexible cloth, 75 cents; stiff cover, $1.00. Mailed on receipt of price.

FOODS AND FOOD ADULTERANTS: Part I. Dairy Products. Issued by direction of the Commissioner of Agriculture. From Dr. H. W. Wiley, Division of Chemistry, U. S. Department of Agriculture. 132 pp.

Contains a great deal of valuable information upon this very interesting and important subject. Illustrations of the crystals of butter, butterine, etc., as they appear under the microscope, from photos by Clifford Richardson, add to its value.

FRESH WATER ALGÆ OF THE UNITED STATES (exclusive of the Diatomaceæ); complemental to *Desmids of the United States;* with two thousand three hundred illustrations, covering one hundred and fifty-seven plates (all colored), including nine additional plates of Desmids. By Rev. Francis Wolle, Bethlehem, Pa. Two volumes, plates and text; cloth. Published by the author.

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